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FOOD VALUES[1]

SUSPICION often attaches the value of the recommendations of the laboratory experimentalist and this reaction may be more or less well founded. In a delightful address to medical students Simon Flexner recently warned his audience not to think of coming to him for medical treatment. A general of the United States Army told me only yesterday that a professor might be able to hold his students to a complete examination upon the subject of the Thirty Years' War, mark each student in accordance with his deserts, and yet the professor might be of the type who would get lost in his own back yard. Such a danger besets the path of him who would speak upon the subject assigned to me to-night. It appears, however, that scientific knowledge of nutrition has sufficiently advanced to make it of some practical service to the people. Dr. Mendel and I would not be speaking together here to-night did we not feel that we had messages to deliver, and yet it must be evident that in this country such messages are merely personal opinions susceptible to challenge and that they carry little weight with the community.

Many are familiar with the report of the Eltzbacher Commission which concerned itself with the food situation in Germany at the outbreak of the war. The commission was intended to bridge the chasm between helpless specialization and superficial versatility. Fifteen of the foremost scientific men of the land approved the report. Mistakes were made, such as overestimates of

[1] Address delivered before the Home Economics Association and the Society of Chemical Industry, March 23, 1917.

the food available and underestimates of the food required by women who took up the work of men and underestimates of the food required during adolescence. The American investigations of Du Bois and of Gephart, which demonstrated the increased food requirement of growing boys, were not there available, and the increase in the rations for such children was not made in Germany or in Belgium until October, 1916.

It was unfortunate that the carrying out of the recommendations of the Eltzbacher Commission was left to politicians, farmers and middlemen. The scientists of the country were not represented and the result was chaos.

Dr. Alonzo E. Taylor has recently published a very complete account regarding the food supply of blockaded Germany. He points out the fact that, in spite of all exhortations and of all regulations, it is the farmer's wife who gets the egg.

In a pamphlet published in June, 1916, Rubner described how the prices of food-stuffs had been enormously increased by the middlemen. The price of meat and of eggs doubled in a month and this happened, of course, without any regard to the cost of production. Rubner frankly states that the lust for gain produced conditions which had no regard to the political conditions of the country and that the efforts to control prices since August, 1914, had been without results. Bread in Germany was rationed and only half the quantity usually taken in peace time was allotted. This represented the omission of twenty per cent. of the usual ration. Meat and milk were scarce and expensive and in some cities were unobtainable. Green vegetables, as a source of nourishment, were as expensive as meat, and potatoes were also scarce. Conditions were such that in some cities the inhabitants received only a third of the usual food supply. The farmer continued to live as had been his wont, whereas the urban dweller suffered. Families dependent upon the earnings of a physician, for example, suffered acutely not only through the withdrawal of the income of the man who was in the army, but also from the high food prices. The hand of the food dictator was restrained on account of a thousand obstacles put in his way through faults inherent in human character.

It may appear a contradiction of terms to hear in the same breath that there is a shortage of food in Germany and yet that the people are not starving. This is due to the fact that in extreme cases of under-nutrition it is possible to reduce the requirement of food to only forty per cent. of its former level. The under-nourished and emaciated may, therefore, live on much less food than those who are well fed and are up to normal weight.

The popular idea that "most people eat too much," which one hears expressed in common table talk, is not true. People who do not change in weight eat just enough to maintain the condition in which they have established themselves. They may, however, lose their surplus fatty tissue by restricting their diet.

Another popular formula which has been elevated to the height of dogma is, "it is not what you eat but what you digest that is of importance." Since the normal person very completely digests all the common food-stuffs, there is little to concern one in this saying. Repeated ignorantly from mouth to mouth, such a remark, even though true, comes to cloak many dietetic absurdities.

An English scientific commission, of which Gowland Hopkins, Noël Paton and others were members, published on February 1 of this year a report of British food conditions. They found that during the five years preceding the war the average annual consumption of food in Great Britain amounted to the equivalent of 51

million million calories, or 3,091 calories per person per day. They assume that the food requirement of 100 men, women and children is the same as that of 77 "men." Therefore each "man" received 4,000 calories daily in a diet containing 113 grams of protein, 571 grams of carbohydrate and 130 grams of fat.

The distribution of this food fuel for the British nation appears in the following table:

TABLE SHOWING ANNUAL YIELD OF CALORIES OF THE CHIEF CLASSES OF FOOD-STUFFS IN THE YEARS 1909–13 IN GREAT BRITAIN

	Energy Value in Millions of Calories	Percentage
Cereals	17,712,000	34.7
Meat	8,890,000	17.4
Dairy produce (including lard and margarin)	8,253,000	16.2
Sugar (including cocoa and chocolate)	6,633,000	13.0
Vegetables	4,812,000	9.4
Cottage and farm products	2,655,000	5.2
Fruit	1,077,000	2.1
Fish	531,000	1.0
Poultry, eggs, game and rabbits	461,000	0.9
	51,024,000	99.9

The commission points out that 30.8 per cent. of the energy in the diet of the people is derived from wheat. Meat yielded 17.4 per cent.; sugar, 13. The three food-stuffs together yielded 61 per cent. of the total energy in the diet. Dairy products and vegetables furnished 25 per cent., and all the rest of the food 13.4 per cent. of the total energy.

The commission emphasizes the fact that if the workers do not get enough to eat they can not do the same amount of work; that a man may by grit and pluck work hard on a low ration, but he is living on himself and soon his work will fail. Stress is laid upon the fact that "in buying food the laboring population is buying energy" and that "a slight reduction of food below the necessary amount causes a large diminution in the working efficiency of the individual." Thus, the troops in the field receive 4,300 to 4,600 calories because they must accomplish hard work and are much exposed to cold. Dr. Murlin has calculated that the "garrison ration" of the United States Army contains 4,400 calories, while the "field ration" contains only 3,800.

The food controller of Great Britain on February 1, 1917, asked the population to voluntarily restrict the consumption of flour, meat and sugar to a measured quantity of these materials per week. This ration would yield about 1,750 calories per "man" daily and leave the individual to supply an equal quantity from other available sources. The individual allotment for each individual each week is 3 lbs. flour, 2½ lbs. meat and ¾ lb. of sugar. The distribution per "man" appears in the following table:

RATION PER "MAN," ADVISED BY BRITISH FOOD CONTROLLER, FEBRUARY 1, 1917

Food per Week, Lbs.	Food per Day					
	Oz.	Grams	Calories	Protein Grams	Carbohydrate Grams	Fat Grams
Flour, 4	9.1	258	939	29	194	3
Meat, 3½	7.6	216	540	41		40
Sugar, 1	2.3	65	267		65	
Total			1,746	70	259	43

This allotment ensures a safe protein ration.

Valuable data are given for the relative cost of production of milk and various meats. Thus, 2.9 pounds of "starch equivalent" in the fodder will produce milk containing 1,000 calories. Three pounds of starch equivalent are required to produce 1,000 calories of pig meat and 4.7 pounds and 9 pounds, respectively, to produce 1,000 calories in veal and in beef. Dairy products, pig meat and veal are therefore far cheaper sources of protein than is beef. The increased production of milk is highly desirable, but it is pointed out that changes in the condition of agriculture take time.

England has already restricted the area of land which can be devoted to promotion of the beer industry. The commission states that repeated experience shows that alcohol is unfavorable to the marching powers of troops.

It is of especial significance that in the stress of war the British state recognizes that the laborer, in buying food for himself, is in the main buying energy to support himself as a machine. It seems to be the crying need of the times that those who purchase food shall be able to know what food is, what they are getting for their money, and whether in asking for bread they are in reality receiving stones.

Murlin was the first to suggest that the government compel manufacturers to place upon each can, or package, or barrel of food sold, the caloric content available as food fuel. Only in this manner can the housewife be informed regarding the relative nutritive value of the beautiful packages she sees in the grocer's window. In my judgment the time is ripe for this procedure. One knows, furthermore, that different proteins have different values, and to this knowledge Dr. Mendel has contributed not a little. I wish to repeat what I said before the Washington Academy of Sciences a year ago:

> The proteins of meat, fish, eggs and milk will replace body protein part for part. Such proteins may be classified as proteins of Grade *A*. Gelatin has practically no power to replace body protein and should be classified as protein of Grade *D*. Wheat contains a mixture of proteins of Grades *A* and *D* in which those of Grade *A* predominate, so that wheat may be classified as containing protein of Grade *B*, whereas from analogous reasoning corn may be said to contain protein of Grade *C*.
>
> An ordinary dietary with a liberal allowance of protein contains 15 per cent. of its calories in that form. A can containing 15 per cent. of its calories in protein should have a star placed with the letter determinative of the grade of protein. For example the label on a can of corn should read, "This can contains *x* calories, of which *y* per cent. are in protein of Grade *C*." A further desirable statement would be as to whether the food-stuff sold contained the natural mineral constituents from the organic source from which it was derived.
>
> I have repeatedly emphasized the desirability that the government should give this information with regard to all food-stuffs sold in packages. The determination of the heat of combustion of a dried sample of food takes fifteen minutes. Probably three hours would suffice to make a complete analysis by a government expert. The manufacturer should send his sample can to the Bureau of Chemistry at Washington, declaring that to be his standard and requesting information regarding his label. He should pay for this analysis as a patentee pays for his patent. If at any time the government should find the manufacturer selling on the market a material of different character than the standard deposited with the government, the manufacturer should be heavily fined.

It seems that these doctrines might be powerfully forwarded at the present time. I believe that they are sound doctrines, potent for accomplishing immeasurable good. It has passed unnoticed that during the current year the cereal products, such as wheat flour, oatmeal, hominy and rice, are all selling on the basis of the same value per thousand calories. The world's necessity has caused this.

A year ago I prepared a table representing the cost of 2,500 calories in various foods and a comparison of the cost of these to-day is presented in the following table:

WEIGHTS OF VARIOUS FOODS NECESSARY TO FURNISH 2,500 CALORIES AND COST AT 91ST STREET AND SECOND AVENUE, NEW YORK CITY

(A man of sedentary occupation requires 2,500 calories daily.)

Articles	Weight		Cost	
	Lbs.	Oz.	1916	1917
Cornmeal	1	8	$0.04½	$0.08
Hominy	1	8	0.04½	0.08
Oatmeal	1	5½	0.05¼	0.07
Flour	1	8	0.06	0.09
Sugar	1	5½	0.06⅔	0.09
Rice	1	8½	0.07¼	0.08
Day-old bread	2	1	0.08¼	0.09
Beans	1	9	0.14	0.21
Potatoes	8	1	0.16	0.40
Apples	11	5	0.38	0.57
25,000 calories	31	11	$1.11	1.76

Experiments from my laboratory with R. J. Anderson have recently demonstrated that the same amount of energy is used by a dog in running three miles in an hour whether the work be done eighteen hours after food ingestion, that is to say, after the food has been digested and absorbed, or whether it is done immediately after the ingestion of glucose in large quantity. If, however, meat in large quantity is given, the extra heat production following upon work amounts not only to the quantity demanded for the work accomplished, but also there is added the considerable quantity of heat produced by the stimulation of metabolism through the substances formed in the breakdown of protein. Meat, therefore, is not the great provider of energy for the accomplishment of mechanical work, but rather carbohydrate food, such as bread, macaroni and rice, all of which are found in the dinner pail of the laborer. These furnish fuel without waste, fuel for accomplishment of the day's work. Fat undoubtedly behaves in a similar fashion, though experiments to demonstrate this have not yet been instituted. Meat in quantity is not necessary for the maintenance of vigorous muscular power. It is gratifying to the palate, but Chittenden has been justified in his belief that small quantities only are essential to repair the wear and tear on the protein content of the organism.

During the recent rise in the cost of foodstuffs I compiled, at the request of an officer of the State Board of Health, the following low-cost meatless dietary of high caloric value designed for a family of five persons, the father at work and the mother doing household work. Potatoes, with their valuable alkaline salts, had to be excluded from the diet because of their prohibitive price. The diets were based on menus given in the excellent book, "Feeding the Family," recently published by Mrs. Mary Swartz Rose. The cost amounted to $1.16 daily for 14,400 calories, or eight cents per thousand calories, which is not a high price.

LOW-COST MEATLESS DIETARY OF HIGH EFFICIENCY VALUE FOR A FAMILY OF FIVE PERSONS, FATHER AT WORK AND MOTHER DOING HOUSEHOLD WORK

Essentials.—Do not buy meat until you have bought *three quarts of milk a day.* Milk contains valuable tissue-building food, valuable salts and invaluable *vitamines* which help to sound health.

If you buy bread remember that day-old bread is much cheaper than freshly baked bread and is just as good a food.

The menus may be arranged as follows:

Breakfast

Corn meal mush,[2] fried (+ milk for children and corn syrup for adults).
Bread (or toast).
Oleomargarin.
Coffee (for adults).
Stewed prunes.
Orange juice for baby.

Luncheon or Supper

Pork and beans[3] (bean soup for young children).
Bread.
Oleomargarin.
Tea with milk and sugar for adults.
Milk for youngest children.
Cereal coffee or cocoa for older children.
Sliced bananas with sugar.[4]

Dinner

Lentil soup.[5]
Boiled rice.[6]
Tomato catsup.

[2] Or oatmeal, or hominy, or farina, or buckwheat cakes.

[3] Or creamed dried beef on toast.

[4] Or stewed dried peaches or the bananas may be boiled in their skins.

[5] Or potato, or bean, or pea soup.

[6] Or spaghetti, or macaroni (with cheese) or baked split peas with bacon.

Bread.
Oleomargarin.
Tea for adults.
Milk for youngest child.
Dried apple pie with cheese for adults.
Dried apple sauce for others.

THE APPROXIMATE COST PER DAY AND THE NUTRITIVE VALUES IN CALORIES APPEAR BELOW

	Amount	Calories	Cost in Cents
Coffee	2⅓ ounces		3
Tea	½ ounce		2
Milk	3 quarts	1,800	27
Bread	2 pounds	2,500	9
Cereal	½ pound	800	4
Oleomargarin	⅜ "	2,500	19
Corn-syrup	⅛ "	650	2
Sugar	⅛ "	450	2
Rice or macaroni	¼ "	1,600	8
Dry navy beans	1 "	1,000	7
Fat pork	10 ounces	1,000	6
Dry fruit (prunes)	6½ "	325	12
Flour, lard, etc., for pie or other extras	1 pound	1,800	15
		14,425	116

As cheaper meats, pork sausages, braised chuck rib of beef, salt cod or herring may be added if finances allow.

This is one method of giving scientific advice. I believe that it may be also possible to arrange in convenient locations throughout a town grocery stores with milk stations adjoining, and that here baskets may be exchanged daily, an empty one for a full one, the baskets varying somewhat from day to day but containing 5,000, 10,000 or 15,000 calories of basic food fuels.

We are told that Joseph fed the Egyptians with grain stored during seven years of plenty. Whether the municipality of the future will purchase wheat and ration bread in quantities sufficient for its inhabitants is a serious question. The railroads of the country receive three thousand million dollars for the service which they render. They must pay high wages and must not increase their charges for what they have to sell. The food problem involves a national expenditure of at least six thousand million dollars a year. The food problem is a national problem which more directly affects living expenses of the very poor than any other problem. The railroads do not enhance the cost of food more than four per cent. of its total cost. The cost of food is, as has been shown, not always dependent upon the cost of production. The cost of gas is regulated by the state and yet the gas companies pay dividends. The cost of bread may some day be lowered by reducing the number of middlemen and by some sort of state control. It is important, also, to find some means to increase the supply of milk. This might be encouraged by a tax on steers of ten dollars each, payable every six months, a procedure which would enhance the price of beef but would induce the farmers to feed their fodder to milch cows or to pigs.

This has brought me to the point where I started—that the professor may get lost in his own back yard. However, it does seem to me that this is a proper time for an American commission to consider these subjects and to report to our government what elemental advice the commission might agree to give. Surely, some consensus of opinion might be arrived at by a commission meeting in Chicago and composed of Mendel, Taylor, McCollum, Folin, Levene, Sherman, Armsby, Langworthy and Benedict. This would mean the submergence of the individual for the instant, in an attempt at welfare work for the nation at large. It would be an experiment worth trying.

Graham Lusk

New York City

GRAVITY AND ISOSTASY

There has recently been issued from the government printing office a volume of 196 quarto pages, known as Special Publication No. 40 of the Coast and Geodetic Survey, bearing the title, "Investigations of Gravity and Isostasy," written by Mr. William Bowie.

This volume is so important to geodesists and geologists that the undersigned believes that its appearance warrants more attention than merely a review of the ordinary kind and length. Hence the present article is presented. The volume is of especial interest because it is based on many more observations of gravity than were formerly available in the Coast and Geodetic Survey, and because the discussion of the data is much more searching and complete than anything heretofore published.

The last preceding publication on this subject from the Coast and Geodetic Survey was issued in 1912.[1] The conclusions in that publication were based almost entirely upon the 124 gravity stations in the United States and 10 in Alaska. In the present publication conclusions are based primarily upon observations at 219 stations in the United States and are tested by observations at 42 stations in Canada, 73 in India and 40 in other parts of the world—374 stations in all. This increase in the number of stations and of the area covered by them is important because the reliability of the conclusions drawn depends upon the completeness with which effects peculiar to a given station or a locality are eliminated, and upon the extent to which supposed general laws are found to be confirmed by the evidence from widely separated areas.

Within the past four years there has been one radical change in the relative method of observing gravity in the United States, with the half-second pendulums, the standard method of the Coast and Geodetic Survey. Formerly each gravity observer carried a transit instrument with him and determined the errors of his chronometers on each clear night. Now he determines the chronometer errors by the time signals sent out from the Naval Observatory at Washington, special studies having shown that these signals are of ample accuracy for the purpose. The time and expense necessary for securing a gravity determination at a station is thus materially reduced, and the rapid increase in the number of gravity stations which is the prime essential of future progress is facilitated.

The most severe test which may be applied to a theory, or a supposed understanding of a group of facts, is a test by prediction. Such a test has been applied by the writer recently to the Coast and Geodetic Survey theories as to the intensity of gravity, including the method there used for computing the effects of topography and isostatic compensation. In the 1912 gravity publication already referred to (Special Publication No. 12) there is a map of the "lines of equal anomaly for the new method of reduction." This map, based upon 124 gravity stations in the United States, may be used in combination with computations for which the methods have been fully published, to predict the intensity of gravity at any point in the United States. Such predictions, for 95 gravity stations, based on the 1912 map have been made by the writer,[2] and compared with the observations made after 1912 at those stations. The difference of prediction and observation was less than .02 dyne (1/49,000 part) in 54 out of the 95 cases. Such a prediction may be made in about three days by an expert computer in Washington at a cost to the government of about $25. On the other hand if a physicist undertakes to determine gravity in his own laboratory by an absolute method, past experience shows that after many weeks of time and an expenditure, including salaries, of many hundreds of dollars, it would be an even chance whether his final result would be within .03 dyne of the truth. To reduce the probable error sufficiently to be equal to that of the prediction which may be made in Washington in three days by a computer would require the equivalent of months of time by an expert physicist.

Still more accurate predictions are certainly now possible by the use of the 1917 map, based on 261 stations in the United States and Canada, which is necessarily a decided improvement for prediction purposes over the

[1] "Effect of Topography and Isostatic Compensation upon the Intensity of Gravity," by William Bowie, Special Publication No. 12.

[2] The writer took advantage in making these predictions of detailed computations which had been made at Washington of the effects of topography and isostatic compensation at these stations.

1912 map, which was based on 124 stations only.

Mr. Bowie's general conclusion in regard to isostasy in the United States is as follows:

> The group of publications of the Coast and Geodetic Survey dealing with deflections and gravity values shows that isostasy exists in a form nearly perfect in the United States as a whole, also that there is nearly perfect isostasy in areas which form comparatively small percentages of the area of the entire country.

The abundant evidence presented supports this conclusion fully. It is important to note that a conclusion of this general character was originally based, not much more than ten years ago, on a small fraction of the evidence now available and that although the amount of evidence has increased greatly, and the evidence has been studied much more intensely, the general conclusion has simply been confirmed abundantly and repeatedly—being modified only in details.

The largest anomaly noted in the United states to date, at Seattle, Washington, —.093 dyne, was recognized as a very large anomaly as early as 1910, when only 89 gravity stations were available in the United States. Since that time with an increase in the number of stations to 219 it is interesting to note that no other anomaly larger than .059 dyne has been found in the United States. So also when the study was extended to Canada (42 stations) the largest anomaly there discovered was only —.045, and in India (73 stations), the largest discovered was —.078 dyne. In other parts of the world only four anomalies have been found which are larger than that at Seattle. Each of these four is on an oceanic island or near a steep continental shore. The anomalies referred to in this paragraph are the residuals after topography and isostatic compensation have been taken into account in the computation. The extension of the computation of isostasy, in a form based upon a few stations in a restricted area, to other stations and to other areas, shows an agreement with the facts which is substantially as close at the new stations and in the extended area as at the original stations in the original area.

Two additional gravity stations having now been occupied near Seattle, it is evident that this largest anomaly in the United States, —.093 dyne, is a comparatively local matter, not a characteristic of a large area. The writer understands that additional unpublished observations emphasize this statement still further.

It is evidently desirable to supplement studies of gravity made by means of stations scattered widely, and somewhat uniformly, over a large area such as the United States, by intensive studies of selected small areas in which a large number of stations are concentrated. The beginning of one such study has been made in the vicinity of Washington, D. C., where observations have been made at seven stations within twenty miles of the capitol.

No discernible general relation is found between areas of recent erosion or recent deposition, on the one hand, and areas of negative anomaly or of positive anomaly, respectively, on the other hand.

The strength of the proof of the validity of the method of computation used in the Coast and Geodetic Survey for taking into account the effects of topography and isostatic compensation upon the intensity of gravity depends in part upon the extent to which the remaining anomalies seem to be independent of the topography around the stations. Hence special intensive studies upon this point have been made repeatedly at the survey. The latest evidence, as set forth in this publication, shows the remaining anomalies to be almost, if not quite, independent of the topography. There is a slight apparent tendency for coast stations to have negative anomalies. But the indications are that this tendency is due to the prevalence of Cenozoic formations along the Atlantic and Gulf Coasts of the United States, not to the nearness of the stations to the coast.

No other method of computation which has been published gives anomalies which are thus independent of the topography.

There is found to be a decided tendency for gravity stations located on Cenozoic formations in the United States and in India to

have negative anomalies, that is, for the intensity of gravity to be below normal at these stations. On the other hand, for stations in the United States on pre-Cambrian formations there is a decided tendency toward positive anomalies, that is, for gravity to be in excess. The evidence of a tendency toward defective gravity in regions in which the surface geologic formations are comparatively recent, and toward excessive gravity where old geologic formations occur at the surface, is full of inconsistencies, and is weak except for the two extremes, the Cenozoic and the pre-Cambrian. It is very suggestive that as the number of stations considered was increased the evidence has become more clear and convincing. The writer believes that the apparent relation cited is real and that it is important to determine, if possible, the true reason why the relation exists. At this, as at many other points, Mr. Bowie is properly cautious in interpretation, though vigorous in presenting the facts and in calling attention to the evidence of relations between the facts.

Mr. Bowie examined fourteen pairs of gravity stations in which the two stations of each pair are at very different elevations, although they are separated by a comparatively short distance in a horizontal sense. In one typical pair, one station, Yavapai, Arizona, is on the edge of the Grand Canyon of the Colorado, and the other station of the pair, although only 2,600 meters away in the horizontal sense, is 1,330 meters lower, in the bottom of the canyon. It is found that in thirteen of the fourteen cases the anomalies remaining on the Coast and Geodetic Survey basis of computation are such that if the anomaly at the lower station is subtracted from the anomaly at the higher station the remainder is positive. The average of the fourteen differences is +.014 dyne. This seemed to indicate that there is some error in the formula used to compute the correction to gravity for elevation. But "a careful study of the matter showed no error in the formula, but it seemed to indicate that the difference in the anomalies could result from the combination of several causes no one of which could alone make the difference."

Mr. Bowie has made an extensive, ingenious and careful study to determine from gravity observations the most probable depth of compensation. The methods of study and the results are fully set forth in the publication. Much difficulty was encountered arising from the intimate manner in which this unknown quantity is unavoidably entangled with other unknowns in the computations, and from the non-sensitiveness of the computed results to an assumed change of depth. There is also some evidence of systematic errors affecting the computed depth. Nevertheless Mr. Bowie has succeeded in getting from the gravity observations an independent determination of the depth of compensation. His conclusion is that the most probable value of the depth of compensation is 96 kilometers and that future values "derived from much more extensive data will fall between 80 and 130 kilometers." Having a keen realization of the difficulties of determining the depth of compensation, the writer recognizes this as a welcome confirmation of the independent and stronger determination of the depth by means of observed deflections of the vertical. The conclusion from the deflections of the vertical in 1910 was that the most probable value of the depth of compensation is 122 kilometers and that it is practically certain that it lies between 100 and 140 kilometers.[3]

Both these computations of the limiting depth of compensation are based upon the assumption that the compensation is uniformly distributed with respect to depth. In each case also the value is believed to be the average depth, it being conceded that the depth may possibly be different in different regions.

Mr. Bowie has computed the reciprocal of the flattening of the earth from gravity observations at 348 stations, of which 216 are in the United States and the remainder in Canada, India and Europe, and finds it to be

[3] "Supplementary Investigation in 1909 of the Figure of the Earth and Isostasy," by John F. Hayford, published by the Coast and Geodetic Survey, p. 77.

297.4 ± 1.0. The value of this quantity derived in 1910 from observed deflections of the vertical in the United States was 297.0 ± 0.5.[4] The very close agreement between these two independent values, an agreement which is well within the probable error of either one, is strong evidence both of a very high degree of accuracy of each and of very successful elimination of systematic errors.

Helmert's value of 1915 is 296.7 ± 0.4. It is based upon 410 gravity stations in various parts of the world. These stations were selected carefully with reference to their relation to topography, a precaution which is necessary with Helmert's method of computation, though not with Mr. Bowie's method. Helmert's method of computation differs radically from that used by Mr. Bowie, yet the two end results are in close agreement.

It is the writer's opinion that Mr. Bowie's monograph on the topic "Investigations of Gravity and Isostasy," is a notable contribution to geodesy. It furnishes a new and broader basis for further studies by geologists and students of geophysics. It furnishes new evidence of the steadily increasing skill and energy with which the Coast and Geodetic Survey is attacking the scientific problems which come within its scope. It is hoped that this article touching upon a few of the main points in the monograph will help arouse such interest as will lead to study of the monograph itself.

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THE NATIONAL ACADEMY OF SCIENCES

The following abstracts have been received of the papers to be presented at the stated meeting of the National Academy of Sciences to be held in Washington on April 16, 17 and 18.

Sex-Determination and Sex-Differentiation in Mammals: Frank R. Lillie, The University of Chicago.

Sex-*determination* in mammals is zygotic, but it does not imply an irreversible tendency to the indicated sex-*differentiation*. Intensification of the male factors of the female zygote from the time of onset of sexual differentiation by action of male sex hormones may bring about very extensive reversal of the indicated sex-differentiation. This result is attained by a study of the twins of cattle. The way is open for an experimental examination of the limits of such reversal, and for an examination of the possibilities in the case of the male zygote.

Sporogony of Malaria Parasites: Photomicrographs of Infected Anopheles: W. V. King, Ph.D., Bureau of Entomology. (Introduced by L. O. Howard.)

The cycle of development through which malaria parasites pass in the body of anopheline mosquitoes has been described in more or less detail by several authors. The illustrations of the developmental phases are, however, mostly taken from drawings which are often schematic and in some cases misleading. The opportunity is therefore taken for presenting the accompanying series of photomicrographs representative of the various stages in the complete sporogonic cycle, and a brief explanatory description of the development as observed in fresh preparations of infected mosquitoes. A few differences from the description as given in some of the texts have been observed and these are substantiated by the illustrations. The work was done in the laboratory of Dr. C. C. Bass, Tulane University, New Orleans.

The Great Barrier Reef of Queensland, Australia: W. M. Davis.

In recent years a number of students of coral reefs have concluded that the Great Barrier Reef of Queensland has been built up on a slightly submerged platform, of origin independent of coral growth and presumably similar to that of the continental shelf which borders the eastern coast of Australia, south of the limits of coral reefs.

There is, however, good reason to think that the present immature reef is an upgrowth from a submerged mature reef plain of an earlier time, if the changes of level that have taken place in the highlands inland from the coast are considered. Following the studies of E. C. Andrews, of Sydney, the highlands of eastern Australia in the region near the boundary between New South Wales and Queensland show the work of several cycles of erosion, each separated by an uplift of several hundred or a thousand feet. When these uplifts took place, the off-shore belt must have been de-

[4] "Supplementary Investigation in 1909 of the Figure of the Earth and Isostasy," p. 77.

pressed and the line of no change must have migrated westward toward the land, because in spite of the repeated uplifts, there are no belts of marine deposits along the shore line. The last of these changes is comparatively recent. It was preceded by a long period of still-stand, during which the border of the mainland was worn down to low relief, even though it consisted of rather resistant rocks. Preceding that still-stand period, a tilting similar to the one that has recently taken place raised the land area and depressed the marine area. Inasmuch as the recent tilting introduced reef growth, there is every reason to think that the earlier tilting also introduced reef growth; but while the reef of recent introduction is still immature, because of its youth, the reef of the earlier cycle must have reached advanced maturity in the long still-stand that followed its beginning, and thus its original lagoon area must have been converted into a reef plain, overlapped by deltas built out from the initial shore lines of that time. It is on the outer part of this reef plain, now submerged, that the present reef appears to have grown up. The fact that, contemporary with both cycles of reef formations off the Queensland coast, a continental shelf was in process of formation by unimpeded marine action off the coast of New South Wales, in no wise invalidates the above conclusions: the two processes are going on at the same time on adjoining coasts now; they may have been similarly synchronous and neighborly at earlier times also.

Searching for a Doubtful Geological Zone in the Canadian Rockies: CHARLES D. WALCOTT.

The stratigraphic position of the Mount Whyte formation of the Cambrian system in the Canadian Rockies having been questioned, I searched for evidence of its place during the field season of 1916 and found that it forms the upper member of the Lower Cambrian terrane both from the evidence of its contained fauna and its stratigraphic position. This conclusion is supported by the sections of the Cambrian formations in the Lake Champlain and the Lower St. Lawrence valleys.

The Influence of Diet upon the Heat Production During Mechanical Work in the Dog: R. J. ANDERSON AND GRAHAM LUSK.

The energy production in a dog moving at the rate of about three miles per hour is the same whether he be given no food or 70 grams of glucose. However, when the dog is given meat the increase in energy production during exercise is equal to the sum of the increases which the two influences of exercise and chemical stimulation through the metabolism of amino-acids would individually have induced.

What Determines the Natural Duration of Life? JACQUES LOEB AND J. H. NORTHROP.

Each species seems to have a characteristic average duration of life. In order to find out the nature of the variables responsible for this duration, experiments were made on the temperature coefficient for the duration of life of an insect (*Drosophila*). The experiments were carried out on breeds free from all microorganisms to avoid the objection that bacterial poisons formed in the intestine influenced the result. It was found that the temperature coefficient was of the order of that of a chemical reaction as we had found previously in non-sterile cultures. This result means that the duration of life is due either to the cumulative formation of harmful substances in the normal metabolism of the body leading to the phenomenon of old age and death; or that it is due to the gradual elimination or destruction of substances without which life becomes impossible.

The Difference in the Action of Antipyretics according to Species of Animals Subjected to this Action, the State of Health of the Animals, the Height of their Normal Temperature and the Substance Employed: T. S. GITHENS (by invitation) AND S. J. MELTZER. From the Department of Physiology and Pharmacology of the Rockefeller Institute.

The principal point of this communication, arrived at by experimental observations, consists in the fact that subcutaneous injections of antipyretics administered to healthy hens, roosters and pigeons, whose normal temperature is regularly higher than that of normal mammals, reduces the temperature by several degrees centigrade, while injections of corresponding doses of the drug into healthy mammals have only either a slight effect or none at all. On the other hand, pyramidon reduces perceptibly the normal temperature in both classes of animals. In human beings all antipyretics reduce febrile temperatures more or less strongly, while the normal temperature is affected by them only slightly.

SCIENTIFIC EVENTS

NITROGENOUS COMPOUNDS IN GERMANY

ACCORDING to an article in the *Revue générale des Sciences* by Professor Camille Matignon abstracted in *Nature,* before the war Germany was the greatest consumer of combined nitrogen. In 1913 the consumption

amounted to 750,000 tons of Chilean nitrate, 35,000 tons of Norwegian nitrate, 46,000 tons of ammonium sulphate, and 30,000 tons of cyanamide. In 1913 great efforts were devoted in Germany to the preparation of materials necessary for war, and no attempt was made to conceal them. The German Ammonium Sulphate Syndicate had a reserve of 43,000 tons, and on the declaration of war there was probably a stock of 100,000 tons of Chilean nitrate. Immediately after the battle of the Marne, when a long war was evidently certain, the production of artificial nitrates and of ammonium sulphate was stimulated, the Badische Aniline Company and Bayer and Co. being subsidized to the extent of 30,000,000 marks for the installation of factories to convert ammonia into nitric acid. In peace time 550,000 tons of ammonium sulphate were produced annually in Germany, but this output was reduced once war was declared. As this substance is a by-product in the manufacture of gas and cast-iron, people in Germany were instigated to use gas and coke instead of coal, and by such means an annual output of 250,000 tons of ammonium sulphate was attained.

The problem of converting the ammonia into nitric acid was solved by the Frank and Caro and the Kayser processes. A French chemist, Kuhlmann, had discovered that ammonia is oxidized to nitrogen peroxide when mixed with air and passed over warm, finely divided platinum. The reaction was employed on a commercial scale by Ostwald, and improved both by Kayser and by Frank and Caro. By the end of 1915 the Anhaltische Maschinenbau Society of Berlin had established thirty installations for the conversion by Frank and Caro's process, and these had a capacity of more than 100,000 tons of nitric acid per month. But this was only one of the methods adopted. Given a cheap source of electrical energy, it was known to be commercially practicable to prepare nitric acid by the direct oxidation of nitrogen in the electric flame, and this process had been established in Norway by Birkeland and Eyde, who used the waterfalls as a source of energy. The Germans have established a factory employing Pauling's process (a modification of that of Birkeland and Eyde) at Muhlenstein, in Saxony, in the neighborhood of the lignite beds, which form the source of energy, and this has an annual output of 6,000 tons of nitric acid.

The third principal method adopted for the preparation of combined nitrogen was the direct synthesis of ammonia. Bosch and Mittasch, two chemical engineers of the Badische Company, had adapted Haber's synthesis to industrial conditions, and the company had established a factory with an annual output of 30,000 tons of synthetic ammonium sulphate. In April, 1914, the company increased its capital in order to raise the output to 130,000 tons, and after the battle of the Marne it was subsidized by the German government to increase the production to 300,000 tons.

Before the war the production of cyanamide in Germany was comparatively small, but it has increased largely under government stimulus. In the direction of the manufacture of manures, it was necessary to economize sulphuric acid, so ammonia was neutralized with nitre cake, and the resulting mixture of sodium and ammonium sulphates was mixed with superphosphate. Moreover, it was found that superphosphate will absorb gaseous ammonia, and although the calcium acid phosphate is thereby converted into the insoluble tricalcic phosphate, it is formed in an easily assimilable condition, and the product is found by experience to act both as a nitrogen and phosphorus manure.

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND INDUSTRIAL RESEARCH

While offering every facility of the laboratories of the Massachusetts Institute of Technology to the United States government for any research in which it with its staff of trained professors can be of service, the institute holds that in addition to the education of its students it has an important function in being helpful to the industrial world. An agreement with Technology by the U. S. Smelting, Refining and Mining Co., to be in force in April, whereby the latter is to avail itself of the

laboratory facilities offered by the institute, is the latest step in forming closer relationships with the industrial world. This Boston-controlled corporation is one of the two large companies of the kind in this country. With the ability of Technology to undertake the work, it has expressed itself, through its president, William G. Sharp, as desirous of availing itself of the advantages offered by the institute. Instead of establishing a private research laboratory of its own it will bring its problems to Technology.

The advantages which accrue to a corporation which makes such an agreement include the economy afforded by not being obliged to establish a laboratory parallelling that of the institute. Such laboratories are very costly, construction and equipment running into the scores of thousands. The institute presents a further advantage that no private laboratory can afford, in that it maintains a great group of allied laboratories. There are unlimited quantities of water, steam, electricity and anything else that is needed, a great library, a large active force for investigation in the student body and unequalled facilities for quick and satisfactory conferences with the instructing staff. Then there is the ease with which other laboratories may be called to help in the solution of any problem. So related are the different industries that hardly any problem lies entirely within the sphere of only one of them. Chemistry turns to electricity, metallurgy to both of these, while mechanical engineering is fundamental.

On the other hand there are advantages to the institute. It has a very costly equipment which it really holds in trust for the community. It is the duty of its officers to make the fullest returns possible. Every use of its facilities by the industrial world is a step towards the realization of its ideals. Cooperation like that with the United States Smelting Co., in the solution of industrial problems makes it the more valuable to the people and the more valuable it becomes the better the chance of greater importance in the future, with the better outlook for the carrying forward of research work that may be of general benefit. That the latter may truly be assured the institute has in its agreement the provision that publication of results be not unduly delayed.

To carry on the special work which this cooperation necessitates, the corporation of Technology has named Henry M. Schleicher, B.S., a graduate of 1910, to be research associate in charge of the work, the general direction resting on Professor H. O. Hoffman, professor of metallurgy. Mr. Schleicher since his graduation has been engaged in research work with two Boston firms, with especial attention to electrolytic separation and flotation.

CHEMISTRY AND THE WAR

THE registrar of the Institute of Chemistry of Great Britain and Ireland, according to *The British Medical Journal,* prefaces an account he has written of the work done by chemists in the war by observing that the government has secured the guidance of chemists and other men of science to assist in the investigation of suggestions and inventions and to bring their knowledge and experience to bear on measures and devices of offense and defense. The country had come to rely so much on foreign sources of supply that means had to be found for dealing promptly and efficiently with the difficulties which arose so soon as importation was stopped by the war. The laboratories of universities and colleges quickly became small factories for the preparation of drugs and medicaments, and many were entrusted with the examination of materials used in the manufacture of explosives. Uniformity in method and the standardization of processes was secured, and students unfit for service with the colors were set to work under the supervision of their professors. Several hundred chemists were engaged to assist in the laboratories and in government and controlled establishments supplying armaments, munitions and other materials of war, and in some branches arrangements were made for probationary training. The staffs of the chemical department of Woolwich arsenal, and of the government laboratory responsible for the examination of foodstuffs and many other requirements of the expeditionary force, were

enlarged. A number of chemists were early given commissions in the army for scientific work, and after the employment of poisonous gases by the enemy men with training in chemistry were enlisted for service in the field. With the assistance of the universities and technical colleges, and various bodies interested in chemistry, an entirely new force was brought into existence; the officers were mainly selected from chemists who already held commissions, whilst non-commissioned officers with knowledge of chemistry were transferred from other units. Both Lord French and Sir Douglas Haig had in their dispatches spoken highly of the work done by this force, which was obtained entirely by voluntary enlistment. The majority of the university graduates and men possessing recognized diplomas who originally enlisted as corporals subsequently received commissions, and when the force was more completely organized a considerable number were transferred to the ministry of munitions. During the campaign against the rebels in South Africa and the Germans in Southwest Africa chemists were attached, by direction of General Botha, to the different brigades, and rendered valuable service. The experience gained in the campaign proves, the registrar thinks, that it is advisable that the state should have control of an organization of professional chemists which would at any time ensure their efficient service to meet the many requirements of the naval, military and air forces. Chemists were required to control the manufacture of munitions, explosives, metals, leather, rubber, oils, gases, food and drugs; for the analysis of all such materials and for research; on active service chemists were required to assist in the control of water supplies, in the detection of poison in streams, in the analysis of water and food, and in the disposal of sewage, and both at home and on active service to assist in devising safeguards against enemy contrivances of a scientific nature, in devising methods of offense, and to instruct the troops in such matters. In summing up the matter, it is said that

> chemists have met the situation with a spirit of true patriotism and have been promptly organized for the service required of them. It is not too much to hope that, as the discoveries of science have been applied to the destruction of humanity, they may be devoted more and more to the furtherance of the arts of peace, to the uplifting of civilization, and the pacification of the world.

SCIENTIFIC NOTES AND NEWS

The spring meeting of the Council of the American Association for the Advancement of Science will be held in Rooms 39–41, new building of the U. S. National Museum, Washington, D. C., on the afternoon of Tuesday, April 17, 1917, at 4:45 o'clock.

The afternoon session of the National Academy of Sciences on April 17 will be devoted to the work of the National Research Council. Reports will be presented by George E. Hale, chairman, National Research Council; Charles D. Walcott, chairman, Military Committee; R. A. Millikan, chairman, Physics Committee; Marston T. Bogert, chairman, Chemistry Committe, and Victor C. Vaughan, chairman, Committee on Medicine and Hygiene.

The evening lecture before the American Philosophical Society will be given in the hall of the Historical Society of Pennsylvania on April 13, by Dr. George E. Hale, his subject being "The Work of the Mount Wilson Observatory."

It is reported that the Rockefeller Institute for Medical Research has appropriated $200,000 for the establishment of a hospital to be used for the instruction of surgeons in the Carrel-Dakin treatment of the wounded. It is expected that Dr. Alexis Carrel will be granted a leave of absence from France to return to New York and assume supervision of the work.

A committee to perfect an organization for an effective mobilization of the medical resources of Massachusetts to aid in obtaining officers for the army and naval medical corps, and to arrange suitable instruction in medical military preparedness, has been formed and is called the Auxiliary Medical Committee for National Defense. Dr. R. P. Strong, professor of tropical medicine in the Harvard Medical School, has been chosen as permanent

chairman of the committee, and Dr. John Warren as temporary secretary.

THE University of Pittsburgh has formed a Research Committee to cooperate with the National Research Council. Dr. George H. Clapp, president of the board of trustees, is chairman of this committee, and the other members are Messrs. Bacon, Brashear, Griffen, Guthrie, Holland, Lincoln, Schlesinger and Thorpe.

DR. CHARLES DOOLITTLE WALCOTT, secretary of the Smithsonian Institution, has been elected a corresponding member in the class of physical sciences of the Royal Academy of Sciences of Bologna, Italy.

DR. A. BELOPOLSKY, astrophysicist at the National Observatory at Pulkowa, Russia, has been promoted to the directorship in succession to the late Dr. Backlund.

DR. JOHN STANLEY PLASKETT, formerly in charge of the department of astrophysics in the Dominion Observatory at Ottawa, has been appointed director of the Dominion Astrophysical Observatory, which is being established at Victoria. The principal instrument of the observatory is a 72-inch reflecting telescope, the mounting for which is in place, and the mirror is nearing completion at the shops of the Brashear Company.

GENERAL GEORGE W. GOETHALS has notified Governor Edge, of New Jersey, that he will accept the position of state engineer, which was created under a special act during the present session of the legislature. General Goethals will have supervision over the projected system of highways, which will cost about $15,000,000.

MR. EZRA LEVIN has been appointed muck crop specialist for the Michigan Agricultural College with field headquarters at Kalamazoo, Michigan. He will spend half of his time in extension work and the other half in research in the Michigan Agricultural Experiment Station.

MR. RAY NELSON, formerly assistant in the Michigan Agricultural College Experiment Station, has been appointed plant pathologist for the Illinois Central Railroad.

THE Sarah Berliner Fellowship for Scientific Research has been awarded to Dr. Marjorie O'Connell, of Columbia University and the American Museum of Natural History. Miss O'Connell has just completed and published a memoir on the "Habitat of the *Eurypterida*," and she will continue her investigations on the conditions of existence of extinct invertebrates, using the evidence furnished by their fossilized remains and by the characters of the strata which contain them.

THE locality at Vero, Florida, from which fossil human remains have been obtained was visited in the latter part of March by Professor E. W. Berry, Dr. R. T. Chamberlin, Dr. E. H. Sellards and Mr. H. Gunter. The objects of the visit were to observe more closely the conditions under which the vertebrate fossils of the deposit are found and to add to the collection of fossil plants. The results will be subsequently published.

A PARTY of ten students from the University of Illinois will utilize the Easter vacation in making a field study of the geologic features along the Ohio River in southern Illinois, under the leadership of Mr. Eliot Blackwelder. A second party under the guidance of Mr. W. S. Bayley will visit the eastern portion of the Ozark Mountains in Missouri, for special field work in economic geology.

DR. OTTO FOLIN, of Harvard University, will deliver on May 18 the third Mellon Lecture of the Society for Biological Research of the University of Pittsburgh Medical School. The subject of this lecture will be "Recent Biological Investigations on Blood and Urine, their Bearing on Clinical and Experimental Medicine."

AT the annual meeting of the Michigan Academy of Sciences, Professor William H. Hobbs gave, on March 28, the presidential address on "The Making of Scientific Theories." This address will be printed in SCIENCE. On the evening of March 29 Professor R. W. Wood, of the Johns Hopkins University, gave a lecture on "Photographing the Invisible." On March 30 Professor George Sarton, of Har-

vard University, gave a lecture on Leonardo da Vinci.

Professor Edward B. Titchener, head of the department of psychology at Cornell University, recently gave a lecture at Princeton University on "The Association of Ideas."

Professor Ellwood B. Spear, of the Massachusetts Institute of Technology, recently delivered lectures on the chemistry of colloids before the Chemical Society of Northeastern College and the New England Chemistry Teachers Association. He also conducted a symposium on colloids at a meeting of the Northeastern Section of the American Chemical Society.

The Association for the Protection of the Adirondacks held its annual business meeting in the galleries of the National Arts Club, New York City, on April 11, 1917, when the Hon. George D. Pratt, state conservation commissioner, delivered an address on "The State Forest Preserve," illustrated with stereopticon views and moving pictures.

Sir Ernest H. Shackleton is returning to England by way of the United States and will lecture in several cities. On April 23 he will lecture before the Geographic Society of Chicago.

Professor Henry B. Cornwall, of Princeton University, died on April 1, at his home in Princeton. He was born at Southport, Conn., in 1844 and was graduated from Columbia University in 1864. Mr. Cornwall was professor of applied chemistry and mineralogy at Princeton University from 1873 to 1910, when he became emeritus professor.

Professor Orson Bennett Johnson, well known for his extensive explorations in the natural history of the Pacific Northwest, died at home in Seattle, Washington, on March 9, aged 69 years. His very large collection of insects has been bequeathed to the University of Washington.

The Rev. O. Pickard-Cambridge, F.R.S., author of works on arachnology, entomology and general natural history, died on March 9, at the age of eighty-eight years.

A sum of one million pounds is allotted in the estimates of the British government as a grant in aid to encourage scientific and industrial research in 1917–18. It will be paid to the account of the Imperial Trust, and any balance will not be surrendered at the close of the financial year. Grants will be made by the directions of a committee of the Privy Council over an agreed period. Following an expenditure of £20,000 in the current year, another £15,000 is needed to pay for the relief expedition fitted out by the admiralty to rescue members of the Imperial Transantarctic Expedition from Elephant Island and also in respect of one half of the expenses of the relief expedition sent in conjunction with the governments of Australia and New Zealand to Ross Sea.

Dr. George E. Hale, chairman of the National Defense Council, has sent the following cablegram to the Royal Society, London; the Academie des Sciences, Paris; the Academy of Sciences, Petrograd, and the Accademia dei Lincei, Rome:

> The entrance of the United States into the war unites our men of science with yours in a common cause. The National Academy of Sciences, acting through the National Research Council, which has been designated by President Wilson and the Council of National Defense to mobolize the research facilities of the country, would gladly cooperate in any scientific researches still underlying the solution of military or industrial problems.

The 1917 meeting of the Association of American Geographers will be held at the University of Chicago, on December 27, 28 and 29. The annual meeting of the National Council of Geography Teachers will probably be held at the same time and place.

Mr. Warren Knaus ('82) has donated to the Entomological Museum of the Kansas State Agricultural College, his valuable collection of Coleoptera. Ever since he was a student in the college, Mr. Knaus has spent practically all his spare time and vacations in collecting and studying Coleoptera. He has made many trips into the arid regions of Mexico, Arizona, Texas and New Mexico to collect insects. These trips have been pro-

ductive of many new species. His collection contains a number of species that are only found in one or two museums in the world, and these were furnished by Mr. Knaus. His collection will be kept as a separate one and will be known as the "Warren Knaus Collection."

THE University of Michigan Biological Station, situated at Douglas Lake, Michigan, will open for the ninth season on July second for a period of eight weeks. Courses in natural history and ecology of animals and plants will be in charge of the following staff:

George R. La Rue, assistant professor of zoology in the University of Michigan, director of the biological station, and assistant professor of zoology.

Reuben Myron Strong, Ph.D., assistant professor of anatomy in Vanderbilt University, professor of zoology.

Max Mapes Ellis, Ph.D., Sc.D., assistant professor of biology in the University of Colorado, assistant professor of zoology.

Frank Caleb Gates, Ph.D., sometime instructor in botany in the University of the Philippines, assistant professor of botany.

John Henry Ehlers, Ph.D., instructor in botany in the University of Michigan, instructor in botany.

Richard Morris Holman, Ph.D., instructor in botany in the University of Michigan, instructor in botany.

Walter Koelz, A.B., assistant in zoology in the University of Michigan, instructor in zoology.

Clyde Bruce Stouffer, M.D., physician to the University of Michigan Health Service, physician to the Biological Station.

The station is open to investigators as well as to students who require direction. Inquiries should be addressed to Dr. George R. La Rue, director of the Biological Station, Ann Arbor, Michigan.

THE Cambridge University Press has issued a collection of essays by Cambridge graduates entitled "Science and the Nation." Chemistry, Physical Research and Metals are discussed by Professors W. J. Pope and W. H. Bragg, and Mr. Rosenhain, of the National Physical Laboratory; Mathematics, by Professor E. W. Hobson; Botany, Forestry and Agriculture, by Mr. F. W. Keeble, director of the Royal Horticultural Gardens, Wisley, Mr. W. Dawson, Professors R. H. Biffen and T. B. Wood; Geology, by Dr. H. H. Thomas, secretary of the Geological Society of London; Medicine and Diseases, by Professors F. G. Hopkins and G. H. F. Nuttall and Dr. G. S. Graham-Smith; while Mr. W. H. R. Rivers deals with the government of subject peoples from the point of view of the anthropologist. The general object of these essays is to emphasize and illustrate the importance of pure science and of original research as bearing directly on national prosperity.

UNIVERSITY AND EDUCATIONAL NEWS

THE Texas legislature has created a branch of the State Agricultural and Mechanical College to be situated at a point to be determined by a commission in the western part of the state. The legislature has also established two junior colleges to be situated at Stephenville and Arlington under the control of the trustees of the state college. The legislature appropriated two million dollars for the rural schools of the state.

THE University of Oregon Medical School is about to expend $115,000 for the construction of the first unit of their new laboratory building on Portland Heights. The new site, some twenty acres, was the gift of the Oregon and Washington Railroad and Navigation Co. Its altitude affords a wonderful view of the surrounding mountains and rivers.

DR. SIMON N. PATTEN, professor of political economy at the University of Pennsylvania, has been retired on the ground that he has attained the age of sixty-five years. Dr. Patten in a statement said the notification given him "raises the question of free speech."

MR. F. A. KENNEDY has resigned from the instructing staff of the mining and metallurgy department of the University of Wisconsin to become a consulting engineer.

DR. G. E. BURGET, of the department of physiology of Chicago University, has been appointed professor of physiology in the University of Oregon Medical School.

DR. C. E. FERREE, of Bryn Mawr College, has been promoted to be professor of experimental psychology.

DISCUSSION AND CORRESPONDENCE

THE SONG OF THE GRASSHOPPER SPARROW (AMMODRAMUS SAVANNARUM AUSTRALIS MAYNARD)

For many years I have been interested in the song of the grasshopper sparrow. This sparrow appears to be fairly common around Washington, D. C. During the early part of the summer of 1916 I frequently heard its peculiar, insect-like, lisping notes, for the bird is more often heard than seen. One male, however, almost invariably perched upon a certain cedar tree in the National Cemetery, near the McClellan Gate, to deliver its dainty, high-pitched it-tip-i-ts-e-e-e-e-e-e-e-e-e-e. This particular bird sang in this manner for many mornings, always singing from the same favorite tree.

For many years I was familiar with this field sparrow around my home town, Oxford, Mass., and have often heard delivered a more complete song than the one usually described by practically all observers and ornithologists. The usual song, it-tip-i-ts-e-e-e-e-e-e-e-e-e-e, frequently terminated with a most remarkable series of faint, rapidly uttered, wild, ecstatic, flowing, warbler-like notes—an exuberant chippety-chippety-chippety, continued for six or eight seconds. This last performance appears to have been a sort of passion song and is remotely like a tiny edition of the oven bird's passionate outburst as it mounts into the air above the woodlands at night. This more complete song is not as commonly heard as the lisping monotone and I have never yet heard it elsewhere than in New England. I feel, however, that this wonderful little twittering rhapsody is a part of its true song, at least in some portions of its range.

In the literature referring to the habits of this sparrow I find only two references to this variation in its song. In "Birds of New York," Memoir 12, Vol. 2, by Elon Howard Eaton, an excellent description of the song by Gerald Thayer is cited. Thayer interprets the usual song as "sit-tit-ts-e-e-e-e-e-e-e-e-e-e-e-e." He does not regard this as the true song of the grasshopper sparrow, however. The true song which he heard was a "long, rambling twitter," uttered in a tone similar to that of the insect-like notes given above, although not as loud, and continuing as long as 10 to 12 seconds. Eaton says:

> This rolling twitter is uttered when the male and female are flying together over the meadows or seated near each other.

L. A. Fuertes has also heard this more complete song of the grasshopper sparrow and likens it to the twittering song of the prairie horned-lark heard at a considerable distance.

H. A. Allard

Washington, D. C.

DECORATIVE AND PICTORIAL ART

To the Editor of Science: As an artist, I was interested in the quotation on art, used as an apt illustration in the interesting article, "Education after the War," by Messrs. Franklin and MacNutt, in Science of December 15. The argument is based on a misconception of the relative values of decorative and pictorial art; a misconception which is entirely modern. The Greek or medieval potter or weaver would have been much surprised if, when he was decorating a jar or a fabric with conventional forms, he had been told that his art was less "living" than that of the picture maker. Pictorial art is no higher or more alive than decorative art; it is simply a different expression of the artist's feeling for the beautiful.

The artist who designed the angel, probably in mosaic, illustrated in the article, desired to fill a given space with a symmetrical arrangement of line, form and color, which would be pleasing to the eye. As he was decorating a church, this arrangement took the form, or rather became the symbol, of an angel. He pointed the thumbs because the pattern was thus improved and he put red spots on the hands because he wanted some bright color in that particular place. (Though for the matter of that, I know of no data which warrant our concluding that angels haven't pointed thumbs or red spots on their palms!) If he had been decorating a banqueting hall, he would have used some symbol of conviviality, such as grapes, or a figure of Bacchus, or whatever symbol was best adapted

to his purpose, *i. e.*, filling a given space with ornament pleasing to the eye.

Decorative art is limited by space, material, etc., and its interest often consists in the artist's effort to use these limitations; while the comparative freedom of pictorial art often causes it to degenerate into imitation —which, of course, is not art at all.

As the technic of art is properly a science, these remarks may not be entirely out of place.

MARGARET ARMSTRONG

THE PRESERVATION OF RECORDS

TO THE EDITOR OF SCIENCE: On reading the article on "Our Duty to the Future," by Professor C. E. Vail, in the December number of the *Scientific Monthly*, it occurred to me that we have at hand, available without special expense, better means of leaving permanent records for the future than any of our predecessors. Practically all printing is done from electrotypes; these electrotypes are made of metals that are not readily corroded by atmospheric action and under proper storage conditions would be very permanent.

In the production of practically all great books, or other records, engravings, etc., electrotypes are used. After serving their purpose in printing the edition many times they are but slightly worn and could be stored compactly in fire-proof and earthquake-proof, dry vaults. Sets of electrotypes, such as those employed in printing the Encyclopedia Britannica, and other reference works, would provide for future generations a considerable knowledge of almost everything of importance pertaining to this era.

Generally speaking, the preservation of records in this way would cost no more than the bullion price of the metal involved in the plates, as otherwise the plates would be remelted and the metal used over.

JOHN S. WRIGHT

SCIENTIFIC BOOKS

How to know the Mosses. By ELIZABETH MARIE DUNHAM. Boston: Houghton, Mifflin Co., 1916. 287 pages, illustrated. $1.25.

This little book is intended as "a popular guide to the mosses of the Northeastern United States" according to its subtitle or, as the cover states, "This handbook of mosses—the first intended for use without a microscope —throws open a new and fascinating field of study to the amateur botanist and nature lover. Keys to 80 genera and descriptions of over 150 species are given." In view of the limitations, and considering how difficult it is to really know the mosses thoroughly, Mrs. Dunham's conscientious effort to introduce a few of our most abundant and easily recognized genera and species to a wider acquaintance will certainly lengthen the season of out-door pleasures and interests for those who love nature at all times of the year! For "the mosses and lichens love the damp shade and the wet frosty season when other plants fade." To acquire even a bowing acquaintance with 80 out of the 200 genera represented in our flora and grow to recognize 150 species out of nearly 3,000, is to learn to have eyes that see and appreciate the subtler beauties of form and color.

The drawings in the text and the full-page illustrations will be found helpful and with the exception of a few indispensable technical terms the book is free from pedantry and unnecessary verbiage. E. G. BRITTON

NEW YORK BOTANICAL GARDEN

SPECIAL ARTICLES

THE EFFECT OF FINENESS OF DIVISION OF PULVERIZED LIMESTONE ON THE YIELD OF CRIMSON CLOVER AND LIME REQUIREMENT OF SOILS

THE practical significance which attaches to studies in the application of lime to soils is responsible for experimentation with pulverized limestone of varying degrees of fineness. Frear[1] cites, together with his own experiments, the comparatively few investigations pertaining to this problem. It has been stated by some authorities that limestone passing a 10-mesh sieve is satisfactory for field practise, while others have advocated material passing a 60-mesh sieve, some claiming that even finer pulverization is to be preferred. The following experiments were planned in 1914 to throw

[1] Frear, W., "Sour Soils and Liming," Dept. Agr. Penn. Bul. 261, 1915.

some light on the comparison of a uniform limestone, which had been subjected to varying degrees of pulverization, with calcium oxide. During the progress of the work, Thomas and Frear[2] published results which are similar to those obtained in the present instance.

Several soils which may be regarded as typical of rather extensive fertile areas were obtained through the courtesy of Drs. P. E. Brown, C. E. Thorne, C. A. Mooers, W. J. Schoene and W. P. Kelly; respectively designated as Carrington (Iowa) silt loam, Wooster (Ohio) silt loam, Cumberland (Tennessee) silt loam, Norfolk (Virginia) sandy loam, Sierra (California) sandy loam and Portsmouth (New Jersey) acid muck. Ten-pound earthenware pots were filled with soil and limestone of 20–40, 60–80, 100–200, 200+ mesh and calcium oxide (c. p.) were added in sufficient quantities to satisfy the lime requirements of the various soils as determined by the Veitch method. Fifteen crimson clover plants were grown in each pot maintained under optimum moisture conditions in the greenhouse. A summary of the results obtained on the five more important soils is recorded in Table I. It is evident that in general, in

TABLE I

Summary showing Relative Effect of Fineness of Division of Pulverized Limestone and CaO on the Yield of Crimson Clover on Various Soils

Treatment	Norfolk (Va.) Sandy Loam	Wooster (O.) Silt Loam	Carrington (Iowa) Silt Loam	Cumberland (Tenn.) Silt Loam	Av.
Check	100	100	100	100	100
20– 40-mesh limestone	112	357	127	134	183
60– 80-mesh limestone	138	364	123	243	217
100–200-mesh limestone	134	419	130	248	233
200+-mesh limestone	146	404	142	262	239
CaO	161	398	153	208	230

all the soils studied, there is an increase in crop yield (dry weight) as the fineness of the limestone is increased. Averaging the five soils it will be seen that the yields with 200-M. are fully one third again as large as where 20-M. limestone was employed, and practically double the yield on the unlimed pots. There is little choice, however, between the 200-M. limestone and calcium oxide, the former giving maximum results on the Ohio and Tennessee soils, while the latter proved superior on the Norfolk and Iowa soils.

An analysis of these crops for total nitrogen (Kjeldahl method) indicated the same general relationship, as is shown in Table II. Namely,

TABLE II

Summary showing Relative Effect of Fineness of Division of Pulverized Limestone and CaO on Total Nitrogen (in Gm.) of Crimson Clover on Various Soils

Treatment	Norfolk (Va.) Sandy Loam	Wooster (O.) Silt Loam	Carrington (Iowa) Silt Loam	Cumberland (Tenn.)	Av.
Check	100	100	100	100	100
20– 40-mesh limestone	159	438	117	136	213
60– 80-mesh limestone	236	475	128	355	299
100–200-mesh limestone	231	500	139	336	302
200+-mesh limestone	255	475	154	373	314
CaO	268	438	157	300	291

as the fineness of division of limestone increased, the total nitrogen (in gm.) increased. Two-hundred-mesh limestone was again superior to calcium oxide in two of the four instances.

The California soil, being decidedly alkaline, responded unfavorably to the application of limestone. That is, the yield of clover as well as the total nitrogen decreased with increasing fineness of division of pulverized limestone. With the acid muck soil (Portsmouth), however, the results were similar to those obtained with the other typical soils, *i. e.*, an increase in fineness of division was responsible for an increase in crop yield and total nitrogen.

After the clover had been harvested, the lime requirements of the soils were again determined for the purpose of comparing the relative neutralizing efficiency of the different materials. As might be expected from theoretical considerations the lime requirement tended to decrease as a result of the applica-

[2] Thomas, W., and Frear, W., *Jour. Ind. Eng. Chem.*, Vol. 7, No. 12 (1915), p. 1,041.

TABLE III

Summary showing Relative Effect of Fineness of Division of Pulverized Limestone and CaO on the Decrease (in Per Cent.) of the Original Lime Requirement of Four Typical Soils

Treatment	Norfolk (Va.) Sandy Loam	Wooster (O.) Silt Loam	Carrington (Iowa) Silt Loam	Cumberland (Tenn.) Silt Loam	Av.
Check	0	0	0	0	0
20– 40-mesh limestone..	35	34	32	33	34
60– 80-mesh limestone..	54	95	58	58	66
100–200-mesh limestone..	62	95	97	73	81
200+-mesh limestone.....	65	88	97	80	83
CaO	62	51	89	65	67

tion of limestone increasing in fineness of division as shown in Table III. The calcium oxide does not appear to be quite as valuable as the 200-M. limestone, which may possibly be due to the fact that the former proved initially superior in neutralizing the acidity, but allowed a subsequent accumulation of acidity to take place, while the latter neutralized the acidity more gradually and in a more progressive manner.

The writer has experiments in progress which indicate that increasing the fineness of division of pulverized limestone is responsible for increasing the biological activities such as ammonification, nitrification and nitrogen-fixation. A study is also being made of the effect of leaching upon the relative efficiency of different finenesses of division of pulverized limestone, with and without ammonium sulphate. This is carried out in galvanized iron tanks (containing 130 lbs. of soil) which have stopcocks permitting the collection of drainage water. In a sandy soil the growth of four successive crops indicates that the 60-M. is superior to the 20-M. or the finer grades of limestone, probably because in such deep pots (17 in.) and such a light soil, the finer material is washed down below the root zone.

NICHOLAS KOPELOFF

RUTGERS COLLEGE,
NEW BRUNSWICK, N. J.,
November 3, 1916

ILLINOIS STATE ACADEMY OF SCIENCE

THE tenth annual meeting of the Illinois State Academy of Science was held at Knox College in Galesburg on February 23 and 24. About one hundred members and delegates and some two hundred citizens of Galesburg attended the various sessions. Over forty new members were elected. Four sessions were held, as follows:

Friday afternoon, a general session at which the following papers were read:

"Safeguarding the Food and Water Supply, a Function of the State," by E. H. S. Bailey.

"Wireless Transmission of Messages in the Olden Time," by Francis E. Nipher.

"Botanical Installation in the Field Museum of Natural History," by Chas. F. Millspaugh.

"The Purpose of Science Teaching in a University," by W. A. Noyes.

"Plant Ecology and its relation to Agriculture," by Warren G. Waterman.

"Activated Sludge Process of Sewage Treatment," by Edward Bartow.

"Contribution of the College to High-school Science Teaching," by John C. Hessler.

On Friday evening, the members of the academy and delegates present and over a hundred citizens of Galesburg enjoyed a banquet at the Galesburg Club. A special session, marking the tenth anniversary of the academy, immediately followed the dinner. At this session, remarks suitable to the occasion were made by the following delegates from other organizations: Professor F. E. Nipher, St. Louis, American Philosophical Society, Academy of Science of St. Louis; Dr. W. A. Noyes, Urbana, National Academy of Sciences; Professor J. E. Wells, Beloit, Connecticut Academy of Arts and Sciences; Professor H. S. Conard, Grinnell, Iowa Academy of Science; Professor E. H. S. Bailey, Lawrence, Kansas Academy of Science; Professor W. H. Hobbs, Ann Arbor, Michigan Academy of Science; Dr. H. S. Pepoon, Chicago, Chicago Academy of Science; Dr. C. W. East, Springfield, Illinois State Board of Health; Dr. F. W. DeWolf, Urbana, Illinois State Geological Survey; Dr. A. R. Crook, Springfield, Illinois State Museum; Mr. E. B. Vliet, Champaign, Chemical Club, University of Illinois; Professor Edward Bartow, Urbana, Illinois State Water Survey; Professor F. L. Stevens, Urbana, Bacteriological Club, University of Illinois.

The following had accepted invitations to be present at this program but were unable to be pres-

ent and responded by letters or telegrams: Dean C. H. Eigenmann, Bloomington, Indiana Academy of Science; Dr. J. B. Shaw, Urbana, Mathematics Club, University of Illinois.

In addition to the greetings brought by these delegates, the American Academy of Arts and Sciences, the California Academy of Sciences and the Ohio Academy of Sciences presented their felicitations by letter regretting that these could not be offered personally.

Dean Eigenmann's message was in the form of an eight-page telegram in which he reported a dream which he had lately experienced. He dreamed that he and his neighbor, Billy Sunday, had died and presented their credentials to his Satanic Majesty at the same time. It appeared that Billy's credentials were not good for permanent admission to the place, but he was allowed to look in and was greatly amazed to find that the numerous men of science whom he had condemned to the place were all there and having a thoroughly good time. They were carrying on all kinds of scientific experiments for which the high temperature was especially suitable, and had so improved the place that Billy longed for permission to remain.

This program lasted until a late hour, and President William Trelease was compelled to forego the reading of the presidential address which he had prepared on the suggestive title: The Producer, the Distributer and the Consumer.

The program for Saturday morning consisted of a symposium on the topic Public Health Problems. The following were the speakers and topics of this program:

Opening of the Symposium, by Dr. J. H. Beard.

"Infant Mortality as a Public Health Problem," by Miss Emma Duke.

"The Control of Infectious Disease," by Dr. C. W. East.

"Rural Sanitation," by Surgeon M. J. White.

"Relation of Water Supplies and Sewage Disposal to Public Health," by Mr. Paul Hansen.

"Cancer, as a Public Health Problem," by Dr. J. F. Percy.

The symposium was followed by a special lecture, complimentary to the people of Galesburg, on the topic "Earth Genesis," by Dr. T. C. Chamberlin, of Chicago University.

On Saturday afternoon, the academy was divided into three sections for the presentation of papers as follows:

SECTION I

Papers on Botany and Allied Subjects

"The Chestnut in Illinois," by William Trelease.

"Dwarf Shore Floras," by H. Walton Clark.

"The Primrose Rocks of Illinois," by H. S. Pepoon (lantern).

"A Dipterocarp Forest," by Frank C. Gates.

"Elementary Teaching of Stem Structure," by Henry S. Conard.

"A Contribution of Knowledge of Porto Rican Fungi," by F. L. Stevens.

"*Phyllachora* on Corn and a General Consideration of the Genus *Phyllachora*," by Nora E. Dalbey.

"*Alternaria* in Apple Spots, an Apple Rot caused by *Gliocladium viride*," by Frances Jean MacInnes.

"Notes on *Cephaleuros Virescens*," by Ruth Higley.

"New or Noteworthy Fungi from Porto Rico," by Ernest M. R. Lamkey.

"Two Porto Rican Plant Diseases," by L. E. Miles.

SECTION II

Papers on Zoology, Physiology and Allied Subjects

"Selection, Regression and Parent-Progeny Correlation in *Aphis avenae* Fab.," by H. E. Ewing.

"Collecting Snails in the Southwest," by James H. Ferriss.

"Amphibians and Reptiles of the Charleston Region," by T. L. Hankinson.

"Crane Town on the Spoon," by Dr. W. S. Strode.

"Mechanism regulating the Laying on and Loss of Flesh."

"The Cause of Exophthalmic Goiter," by W. E. Burge.

"The Effect of Starvation on the Catalase Content of Tissues," by Alma J. Neill.

"Recent Research in the Department of Household Science, University of Illinois," by Ruth Wheeler.

"The Content of a General Science Course," by J. F. Groves.

SECTION III

Papers on Physics, Chemistry, Geology and Allied Subjects

"The Origin of Desert Depression," by William Herbert Hobbs.

"The Thebes Sandstone and Orchard Creek Shale, and their Faunas," by T. E. Savage.

"The Physical History of the Upper Mississippi Valley During the Late Paleozoic," by Francis M. Van Tuyl.

"The Climatic History of Alaska, from a New Viewpoint," by Eliot Blackwelder.

"An Improved Form of High Vacuum, High Speed Mercury Vapor Air Pump" (lantern).

"A Simple Demonstration Tube for Exhibiting the Mercury Hammer, Glow by Mercury Friction and the Vaporization of Mercury at Reduced Pressures" (demonstration).

"Visible Color Effects in a Positive Ray Tube Containing Helium" (demonstration, lantern), by Chas. T. Knipp.

"A Study of Indoor Humidity" (lantern).

"The Rate of Combustion of Some Illinois Coals" (lantern), by F. D. Barber.

"Derivatives of Iso-Camphoric Acid," by Glen S. Skinner.

The officers elected for the ensuing year are as follows: Dr. J. C. Hessler, James Millikin University, Decatur, President; James H. Ferris, Joliet Vice-president; Professor T. L. Hankinson, State Normal School, Charleston, Treasurer; Professor J. L. Pricer, State Normal University, Normal, Secretary.

J. L. PRICER,
Secretary

NORMAL, ILL.

SOCIETIES AND ACADEMIES

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 564th meeting of the society was held in the assembly hall of the Cosmos Club, Saturday, January 27, 1917, called to order at 8 P.M. by President Hay with 45 persons present.

Under the heading of brief notes, Messrs. W. L. McAtee and A. Wetmore made remarks on certain misconceptions as to the notes of some common species of birds and as to a theory of the migration of birds.

Under the heading exhibition of specimens, Dr. O. P. Hay showed a metacarpal of a horse with well-developed lateral metacarpals, and three fused metacarpals of a cow each with well-developed digits.

Dr. L. O. Howard commented on an enthusiastic antimosquito convention, which he had lately attended in New Jersey.

The regular program consisted of two communications:

Exploitation of Neglected Aquatic Resources: H. M. SMITH.

Dr. Smith called attention to many forms of fishes not used as food by the American public, but which are of pleasing taste and good food value. Many of these have long been used for food by Europeans, especially about the North Sea. He gave a brief résumé of the discovery, disappearance, rediscovery of the tilefish and of its successful introduction to the consumer through exploitation by the Bureau of Fisheries. He then described the dogfish and its habits destructive to other fish and the losses caused by it to fishermen. He told of the efforts now being made by the Bureau of Fisheries to market the dogfish as a food. Under the name of grayfish it is now being successfully canned and marketed by some of the New England fisheries and by some of the salmon canneries on the Pacific coast during the winter months when salmon are unattainable. The canned meat not only constitutes one of the cheapest forms of protein now available, but the livers of the dogfish yield a valuable oil; the oviducts, eggs; and the skin a leather which has many possibilities. Discussion by Messrs. Ames, Bean and Doolittle.

Showers of Organic Matter: W. L. MCATEE.

Under this heading Mr. McAtee gave a review of the various apocryphal and authentic instances in which hay, grain, various insects, encysted animalcules, worms, frogs, toads, fishes and birds had fallen from the sky. The explanation was offered that the objects had been carried aloft by violent currents of air.

THE 565th meeting of the society was held in the assembly hall of the Cosmos Club, Saturday, February 10, 1917, called to order at 8 P.M., by President Hay with 30 persons present.

Two formal communications were presented:

A Mortality of Fishes on the West Coast of Florida: H. F. TAYLOR.

During the months of October and November, 1916, vast numbers of fishes were killed in the region mentioned, by some obscure cause. It appears to be a recurrence of the phenomenon observed in 1844, 1854, 1878, 1880, 1882, 1883, 1908. Of the dead fishes 63 species, representing 37 families, were identified. The animals killed were confined, with the exception of king crabs, sea urchins and sponges to the class Pisces. Various suggested causes were examined; foul Everglade water, diseases and volcanic eruptions are inadequate explanations. Evidence at hand seems rather to show that the cause of mortality was the release of occluded bottom gases by small seismic disturbances, or possibly by abnormally large numbers of Peridinii. Mr. Taylor's paper was illustrated by lan-

tern-slide views of the region involved and of strips of shore showing the large numbers of stricken fishes. His paper was discussed by Messrs. Hay, Bartsch, Goldman, Radcliffe and others.

Changes in the Avifauna about Burlington, Iowa, 1885 to 1917: Paul Bartsch.

From 1885 to 1893 Dr. Bartsch was resident of Burlington and an enthusiastic bird collector. In the ideal conditions found for birds at Burlington he had recorded 275 species. Since 1893 he has been a sporadic visitor to Burlington, but has always retained his interest in the local avifauna. Passenger pigeons, Carolina parakeets, whooping and sandhill cranes, trumpeter swans were found about Burlington, but are no longer seen. The same is true of the Mississippi kite, the swallow-tailed kite, wild turkey and prairie chickens, the latter having been shot in times past from the speaker's porch. The prothonotary warbler, once common, appears to have gone northward. New birds now found at Burlington have come from the west, such as western meadowlark, red-shafted flicker. Other newcomers are the tufted tit and Carolina wren. Many of these changes are due to human agencies, some are unexplainable. Dr. Bartch's paper was discussed by Messrs. Hay, McAtee, Wilcox, Goldman, Jackson and others.

M. W. Lyon, Jr.,
Recording Secretary

ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 507th meeting of the society was held at the New National Museum on February 20. The speaker of the afternoon was Dr. I. M. Casanowicz, of the New National Museum, who presented a paper on "The Fish in Cult, Myth and Symbol."

Dr. Casanowicz said: "The fish, as the inhabitant of the mysterious, indestructible, never-resting water, early impressed man deeply and was regarded by him as the genius and representative of the life-producing element." The speaker stated that one of the principal centers of ichthyolatry in antiquity was Syria, where a fish goddess named Derketo-Atargatios was worshipped as the personification of the fructifying power of the water. Belief in the fish as a medium of transformation and incarnation of spirits was noted among the ancients, while in later times the fish, next to the bird, seems to have been a symbol of the departed human soul. The fish as carrier of man across the water was illustrated by quotations from Herodotus and the Bible; and parallel narratives of a man being swallowed by a sea monster were quoted from Greek, Polynesian and Cherokee lore.

In conclusion the speaker stated that the fish was generally considered as a being of good omen, benevolent and beneficent toward man, and, by reason of its own great fertility, a symbol of increase and abundance.

The 508th meeting of the society was held at the New National Museum, on March 6. This meeting was devoted to a general discussion, the subject being, "Problems connected with the Distribution of the Aboriginal Population of America." The speakers were Dr. John R. Swanton, Dr. Aleš Hrdlička, Dr. Truman Michelson, Professor William H. Holmes, Dr. Walter Hough, Dr. J. Walter Fewkes and Mr. Francis LaFlesche.

Dr. Swanton introduced the discussion by stating that the subject divided itself into a consideration of the distribution of aboriginal population in America quantitatively and qualitatively. "Populations," said Dr. Swanton, "may be classified qualitatively according to their physical characteristics, languages, cultural features, social organization and so on. Archeology has a bearing on all these." He gave as one of the principal problems to be considered the bearing of the data of each class on the generally admitted Asiatic origin of the American Indians and their diffusion from the northwest.

Dr. Hrdlička, speaking from the standpoint of physical anthropology, stated that the distribution of different physical types on the American continent has always been one of the main problems of his branch of science in this country. Dr. Michelson, speaking on the linguistics of the Indians, said: "There is no single type of language, no fundamental structure that is the same in all linguistic stocks, though we find resemblances between them." Dr. Holmes spoke briefly on the changes in the culture of the Indian which have been produced by environment; and Dr. Hough noted that transportation and artificial fire-making were essential to the early inhabitants of this continent. Dr. Fewkes called attention to the fact that early migrations in North and South America were determined in large measure by the mountain ranges and rivers, and by the food supply. Mr. LaFlesche stated that the ancient rites of the Siouan stock show that the migrations of the people were influenced by the search for food. The first animal mentioned in these rites is the elk, succeeded by the deer, and later by the buffalo, at which period the mention of corn appears for the first time.

Frances Densmore,
Secretary